

CIRCULAR DEQ-20

STANDARDS FOR NON-PUBLIC WATER SYSTEMS

2023 EDITION



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1. APPLICATION & GENERAL STANDARDS

1.1. PURPOSE AND APPLICABILITY

This 2023 version of DEQ Circular 20 is the first version of this circular. The information in this circular is based on information contained in the 2018 version of Circular DEQ-3 and sections of the Administrative Rules of Montana (ARM) 17.36 that were last revised in 2018.

This circular provides design standards for non-public water systems which are defined as individual, shared and multiple-user water systems. Non-public water systems are water supply systems with a population of less than 25 persons served less than 60 days per year or with less than 15 connections, that do not meet the definition listed in Title 75, chapter 6, MCA, and ARM 17, chapter 38, subchapter 1. In estimating the population that will be served by a proposed residential system, the reviewing authority shall multiply the number of living units by 2.5.

Plans for facilities that will be public water supply must be reviewed in accordance with the provisions of Title 75, chapter 6, Montana code Annotated (MCA), and ARM 17, chapter 38, subchapter 1. Definitions relevant to this circular are adopted in ARM 17.36.101. Illustrations, Spreadsheets and Examples

The images, pictures, examples, and spreadsheets found in this Circular are presented for illustration purposes only and may not include all design requirements. Please refer to the specific rules in this Circular pertaining to each element for details.

1.2. DEVIATIONS FROM STANDARDS

The terms shall, must, may not, and require indicate mandatory items, and applicants must obtain approval to deviate from these mandatory requirements. Other items, such as should, may, recommended, and preferred, indicate desirable procedures or methods. These non-mandatory items serve as guidelines for designers and do not require approval for deviations.

Deviations from the requirements of this circular may be granted pursuant to ARM 17.36.601. A request for a deviation must include adequate justification. "Engineering judgment" or "professional opinion" without supporting data is not adequate justification. The justification must address each of the items included in ARM 17.36.601. Additionally, justification must address potential adverse impacts, such as flooding and erosion, to neighboring properties.

The Department will review the request and make a final determination on whether a deviation may be granted.

1.3. APPLICATION MATERIALS

As part of the review of a joint subdivision application under MCA 76-4, evidence that existing or proposed individual, shared, or multiple-user water supply systems are sufficient in terms of quantity, quality, and dependability must be provided. Each application must include a design report as described in the specific sections.

1.3.1. Design Report

Applications shall contain all of the items listed below:

- a. Identify and discuss all existing and proposed water supply sources. Identify the location of each source on the Lot Layout as described in section 1.3.2
- b. Identify and discuss whether any existing water supply source will be abandoned as a part of the project as described in section 1.3.3.
- c. Provide information pertaining to water dependability for the proposed water supply system as described in sections 1.2.2 and 2.1.1 or 3.1.1
- d. Provide information pertaining to water quality for the proposed water supply system as described in section 1.2.3 and 2.1.2 or 3.1.2
- e. Provide description of any existing or proposed water disinfection or treatment systems for drinking water contaminants as described in section 2.3 or 3.3.
- f. Identify and discuss all potential sources of contamination within 500 feet of the proposed water supply system\ and all lagoons within 1000 feet as described in section 2.14.

1.3.2. Water Dependability Information

This section specifies the design standards to ensure that the necessary quantity and quality of water must be available at all times. The applicant shall demonstrate that water supply systems provide an adequate supply by showing that the following criteria are met:

- a. For individual and shared water supply systems, the flows required in Chapter 2
- b. For multiple-user water supply systems, the flows required in Chapter 3

The reviewing authority may restrict the volume of water withdrawn from a proposed water source for a subdivision and require the applicant to submit information in addition to that required in Chapter 2 through 4 to demonstrate the dependability of the ground water supply if the reviewing authority has reason to believe that dependability is questionable.

The applicant shall provide evidence that the aquifer can supply water to wells in at least an amount equal to the proposed ground water withdrawals. The well may provide this water either by itself or through recharge from surrounding geologic units.

1.3.3. Water Quality Information

The reviewing authority may require testing of wells located near the project boundary for additional constituents for which human health standards are listed in Department Circular DEQ-7 or in ARM Title 17, chapter 38, subchapter 2, if the reviewing authority believes that those constituents may be present in harmful concentrations. The applicant shall demonstrate that water quality is sufficient for the proposed uses by meeting the requirements listed below:

- a. For individual and shared water supply systems, the water quality required in Chapter 2
- b. For multiple-user water supply systems, the water quality required in Chapter 3

1.3.4. Water Rights Information

The applicant must provide correspondence from the Department of Natural Resources and Conservation (DNRC) Water Resources Division stating that the water supply either:

- a. Is exempt from water rights permitting requirements; or
- b. Has a water right, as defined in § 85-2-422, MCA.

For projects within reservation boundaries, water rights predetermination information may be provided by the appropriate tribal authority or equivalent water rights agency with appropriate jurisdiction.

1.3.5. User Agreements

If shared or multiple-user wells propose to supply water to living units or commercial units on separate parcels or to separate condominium units, water user agreements must be provided with the application materials that identifies the rights and responsibilities of each user in accordance with ARM 17.36.122.

1.3.6. Easements

If an application includes shared or multiple-user wells to supply water to living units or commercial units on separate parcels or to separate condominium units, easements to allow adequate operation and maintenance of the system must meet the requirements of ARM 17.36.122. For projects adjacent to public land or with a shared landowner, the department may allow means other than easements to assure access to allow adequate operation and maintenance of the system.

1.4. GENERAL STANDARDS FOR ALL WATER SUPPLY SYSTEMS

This section presents standards that apply to all existing and proposed non-public water supply systems.

1.4.1. Source

A surface water or ground water source under the direct influence of surface water, may not be used as a water source for a non-public system. No deviation is available from this requirement. Department criteria for evaluating surface water influence in individual and shared wells are listed in Chapter 2. Department criteria for evaluating surface water influence in multiple-user wells are listed in Chapter 3.

1.4.2. Location

- a. The location of the proposed water source must be shown on the lot layout, indicating distances to any potential sources of contamination within 100 feet and any known drainfields and mixing zones as defined in ARM 17.30.502. The reviewing authority may require that all potential sources of contamination be shown in accordance with Department Circular PWS-6.
- b. Each existing and proposed drinking water well must be centered within a 100-foot radius well isolation zone.
- c. Each proposed well isolation zone as defined in Arm 17.36.101 must be located wholly within the boundaries a lot, unless the criteria listed in ARM 17.36.1229(4) are met.
- d. The minimum setback distances set out in ARM 17.36.323 must be maintained for all new and existing water sources. A drinking water supply well may not be constructed

within 100 feet of a ground water mixing zone granted pursuant to ARM Title 17, chapter 30, subchapter 5.

- e. The reviewing authority may require greater than a 100-foot horizontal separation between a well and surface water if there is a potential that the well may be influenced by contaminants in the surface water. **In determining the appropriate separation between a well and surface water, the reviewing authority may consider factors such as well location, well construction, aquifer material, hydraulic connection between the aquifer and watercourse, and other evidence of the potential for surface water contamination. The reviewing authority may also require that the proposed water source be tested for surface water influence in accordance with Department Circular PWS-5.**
- f. For lots two acres in size or less, the applicant shall physically identify the proposed well location by staking or other acceptable means of identification. For lots greater than two acres in size, the reviewing authority may require the applicant to physically identify the well location.

1.4.3. Well abandonment

All wells that have no further use must be abandoned in accordance with ARM 36.21.670 through 36.21.678.

1.5. REQUIREMENTS FOR SYSTEMS DESIGNED BY PROFESSIONAL ENGINEERS

Multiple-user water supply systems with six or more service connections, including service connections outside of a project boundary, must be designed by a professional engineer. If an existing system is expanded to serve six or more connections total, the expansion must be designed by a professional engineer.

The reviewing authority may require smaller systems that it determines to be complex (e.g., involving water treatment or a water supply system with substantial pressure difference through the distribution system) to be designed by a professional engineer.

Water systems required to be designed by a professional engineer are subject to the requirements of ARM 17.36.121.

1.6. EXISTING SYSTEMS

This section applies to existing nonpublic water supply systems. For existing nonpublic water supply systems, the applicant shall submit information to allow the reviewing authority to review the quality, quantity, and dependability of the existing system.

The applicant shall submit to the reviewing authority the following information for all nonpublic systems included in a subdivision application:

- a. The applicant shall submit, for each existing water supply source, water quality analyses for nitrates, nitrites, arsenic and specific conductance. If an existing well is currently being used as a potable water supply within a proposed subdivision, The nitrates, nitrites, arsenic and specific conductance sample may not be older than one year prior to the date of the application.

- b. A total coliform analysis must also be conducted. The coliform sample may not be older than six months prior to the date of application. If an existing well is not currently used as a potable water supply but will be converted to a potable water supply, a total coliform analysis must be conducted when it is put into use.
- c. All analysis must be performed by a laboratory certified by the Department of Public Health and Human Services for analyses of water samples for public water systems. The reviewing authority may not approve the use of an existing system if there is evidence that, after appropriate treatment, the concentration of any ground water constituent exceeds the human health standards in Department Circular DEQ-7, or the maximum contaminant levels established in ARM Title 17, chapter 38, subchapter 2.
- d. To characterize the water supply, the applicant must show, through a well log or other means, the depth to static water in the well and the total well depth.

Existing nonpublic water supply systems that have not been previously approved under Title 76, chapter 4, MCA, or are proposing a change in use, must meet all requirements of this circular, unless the Department grants a deviation pursuant ARM 17.36.601.

For individual and shared water systems only, no deviation is required for grouting depth or casing seal if the well meets the requirements in place for potable water in existence at the time of construction. Non-public grouting requirements listed in ARM 36.21.654(3) changed effective 7/16/10 from 18 feet to 25 feet.

Compliance with well grouting requirements shall be evaluated based on the grouting depth in feet described in the well log. If no depth is listed, the reviewing authority will assume that the minimum depth was met if the casing depth is a minimum of 25 feet (or 18 if applicable). The reviewing authority shall use the well log to determine the depth of continuously fed bentonite and casing. The reviewing authority may consider any other documentation available in addition to the well log.

For previously approved non-public water supply systems, the applicant must submit evidence that the system meets the conditions of that approval or the requirements of this circular. If a requirement of this circular would prevent the previously approved use of the water supply system, the system may use the rules in effect at the time of approval.

1.7. ALTERNATE WATER SUPPLY SYSTEMS

Alternate water supply systems addressed in this circular include only:

- a. Springs
- b. Cistern with hauled water,
- c. Cistern with water supplied by a well that does not meet the minimum flow requirements of this Circular,
- d. Cistern with water supplied by a public water supply system, or

An alternate water supply system proposed for non-public water systems within the project boundary may only be developed if the applicant provides the following:

- a. Evidence that ground water quality, quantity, or dependability is unacceptable; and
- b. Evidence that the alternate water source is sufficient in terms of quality, quantity, and dependability; and

- c. Evidence that the proposed alternate water supply complies with the other requirements set out in this circular.

1.7.1. Springs

Springs, when developed as an alternate water system for individual or shared water supply systems, must be constructed in accordance with plans and specifications approved by the reviewing authority and in accordance with Chapter 5 of this Circular.

Springs may not be used as sources for multiple-user water systems.

1.7.2. Cisterns

Cisterns, when developed as an alternate water system, must be constructed in accordance with plans and specifications approved by the reviewing authority and in accordance with Chapter 6 of this Circular.

2. INDIVIDUAL AND SHARED WATER SYSTEMS

Individual and shared wells are separate and distinct water system types. However, these water system types have many overlapping requirements. In selecting the source of water to be developed, the applicant must demonstrate, to the satisfaction of the reviewing authority, that an adequate quantity and quality of water will be available and that the water delivered to the consumer will meet the requirements outlined in this circular.

2.1. GROUND WATER

Ground water sources addressed in this section include all water from dug, drilled, bored, or driven wells.

To establish the available water quality, quantity, and dependability, the reviewing authority may require construction and testing of the well at the approved location prior to approval of other system components.

2.1.1. Quantity

The applicant shall demonstrate that ground water quantity is sufficient for the proposed uses.

a. Minimum Flows

- i. For each individual water system, the applicant must provide evidence of a sustained yield of at least:
 1. Ten (10) gallons per minute over a one-hour period.
 2. Six (6) gallons per minute over a two-hour period; or
 3. Four (4) gallons per minute over a four-hour period.
- ii. For each shared water system, the applicant must provide evidence of a sustained yield of at least:
 1. Fifteen (15) gallons per minute over a one-hour period
 2. Ten (10) gallons per minute over a two-hour period
- iii. A deviation under ARM 17.36.601 is not required to request a sustained yield lower than those listed in i and ii if the applicant provides adequate justification for the requested yield, including a fixture unit analysis acceptable to the reviewing authority, such as UPC or AWWA. The individual or shared water system must produce the lower volume of water over a one-hour period demonstrated through pump testing within the project boundary or well logs.
- iv. For purposes of the minimum flows identified, sustained yield must be based on water that is supplied from the aquifer, not from well bore storage.
- v. A description of the proposed ground water source, including approximate depth to water bearing zones and lithology of the aquifer must be provided.
- vi. The minimum flows required must be demonstrated through one or more of the following, as determined by the reviewing authority:

1. Test wells within the project boundary.
 2. Well logs and testing of nearby wells.
 3. Hydrogeological reports; or
 4. Ground water modeling.
- vii. Where the sustained yield from a groundwater source cannot meet the minimum flows in 2.1.1.a.i.-iv, a supplemental cistern designed in accordance with Chapter 6 may be used if:
1. The sustained yield is shown to be equal to or exceed three times the average day demand plus irrigation.
 2. The applicant demonstrates the sustained yield through well logs and testing of nearby wells or through a pump test. The pump test on the proposed groundwater source must be performed in accordance with Section 4.2.4.a. with the following exceptions:
 - a. the pump test may be run in any combination of time and discharge to show the total volume of water pumped within a 24-hour period exceeds three (3) times the average day demand plus irrigation.
 - b. The volume of water cannot include well casing bore storage
 - c. Results must be submitted on a form acceptable to the Department clearly showing time since pump test began, drawdown or residual drawdown, and discharge at the required recording interval.
 - d. Residual drawdown measurements must be taken for a period of 24 hours after the pump is turned off, or until full recovery, whichever is longer

3. Pump Tests

The reviewing authority may require a pump test for one or more wells to demonstrate sufficient quantity and dependability of the ground water sources. The tests must be conducted in accordance with criteria outlined in Chapter 4 for multiple-user water wells.

4. Unconfined Aquifer

The reviewing authority may require additional information when the proposed individual water supply is an unconfined aquifer, and a significant recharge source is from irrigation ditches or irrigated fields. The additional information will require the applicant to demonstrate that the source will produce water that is sufficient in terms of quality, quantity, and dependability if all irrigation-related recharge to the aquifer is eliminated.

2.1.2. Quality

The applicant shall demonstrate that water quality is sufficient for the proposed uses. The reviewing authority may not approve a proposed water supply system if there is evidence that, after approved treatment as outlined this circular, the concentration of any water quality constituent exceeds the human health standards in Department Circular DEQ-7, or the maximum contaminant levels established in ARM Title 17, chapter 38, subchapter 2.

The necessary quality and quantity of water must be available at all times unless depleted by emergencies. Treatment is addressed in Section 2.4.

Surface Water Influence

- a. For proposed and existing individual and shared wells, the reviewing authority must evaluate direct surface water influence risk for springs, irrigation galleries or horizontal wells. Other sources may be evaluated if the reviewing authority has reason to believe that the source is at risk for direct surface water influence.
- b. If the reviewing authority determines there is a direct surface water influence risk the Department will require construction and testing separately before approval can go forward as well as the sampling listed below:
 - i. Monthly lab testing of conductivity and turbidity for one year.
 - ii. Monthly Total Coliform bacteria testing for one year.
 - iii. Quarterly nitrate-nitrite testing for one year.
 - iv. Testing for organisms that indicate direct surface water influence using the Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA), Environmental Protection Agency, EPA 910/0-92-029 (Oct. 1992).
- c. If the sampling listed in (b) indicates a likelihood of direct surface water influence, the water source will not be allowed.

Sampling

- a. The applicant must submit to the reviewing authority water quality data that shows the concentration of the following constituents:
 - i. Nitrate and Nitrite
 - ii. Specific Conductance
 - iii. Arsenic
 - iv. Total Coliform Bacteria
- b. Samples must be taken from wells in the proposed project boundaries. If no wells exist in the proposed project boundaries, the reviewing authority may accept samples from nearby water wells that are completed in the same aquifer as that proposed for the subdivision water supply. The samples may not be older than one year prior to the date of application.
- c. Analyses must be conducted by a laboratory certified by the Department of Public Health and Human Services for analyses of water samples for public water systems.
- d. Nitrate Sampling Requirement: As provided by ARM 17.36.103(1)(f), the department requires a nitrate+ nitrite analysis for proposed water sources. The nitrate analysis should be conducted using water from the same well used for the arsenic and specific conductance analysis.
- e. Arsenic Sampling Requirement: As provided by ARM 17.36.103(1)(f), the department requires an arsenic analysis (Method 200.7, 200.8, 200.9 at 0.001 mg/l or lower

reporting limit) for proposed water sources. The arsenic must be conducted using water from the same well used for the nitrate and specific conductance analysis.

- f. Total Coliform Bacteria.
 - i. If an existing well is currently being used as a potable water supply within a project boundary, a total coliform analysis must also be conducted. The coliform sample may not be older than six months prior to the date of application.
 - ii. If an existing well is not currently used as a potable water supply but will be converted to a potable water supply, a total coliform analysis must be conducted when put into use.
- g. The applicant shall provide the following from every well that a ground water sample is collected from:
 - i. A well log. If a well log is not available, the applicant shall provide information about the well depth and depth to static water level.
 - ii. Well locations shown on a topographic map or lot layout document.
 - iii. If requested, additional information to demonstrate that ground water quality is sufficient for the proposed uses.
- a. The reviewing authority may require testing of wells located near the project boundary for additional constituents for which human health standards are listed in Department Circular DEQ-7, or in ARM Title 17, chapter 38, subchapter 2, if the reviewing authority believes that those constituents may be present in harmful concentrations.

2.1.3. Well Construction

Individual and shared wells must be constructed by a licensed water well contractor in accordance with the requirements of Title 37, Chapter 43, MCA, and ARM Title 36, chapter 21, in place at the time of well construction.

The reviewing authority may require additional well construction and/or testing requirements not required in ARM Title 36, chapter 21, subchapter 6 to ensure that wells within a particular subdivision will provide an adequate water supply.

Individual and shared wells must meet the following criteria:

Well Logs

- a. Provide a well log where available for all wells within the project boundary.
- b. If well logs are not available, the following well information must be provided:
 - i. Static Water Level
 - ii. Total Depth
 - iii. Description of casing material and size
 - iv. Photo of the well casing and cap
 - v. Grouting cannot be substantiated without well log, a deviation request must be provided, pursuant to ARM 36.21 well drilling standards.
- iii. If well logs are not available, the following information may be requested by the reviewing authority:
 - 1. Well logs in the vicinity

2. Video inspection inside casing to determine perforated depth

Minimum Depth

Wells must have unperforated casing to a minimum depth of 25 feet below ground surface. A deviation from the minimum depth may be granted, pursuant to Section 1.7 of this Circular. The deviation request must be based on geological information provided by the applicant showing that a lesser depth will ensure the requirements of this Circular are met.

The reviewing authority may require unperforated casing to a depth greater than 25 feet of water if better chemical or microbiological quality can be obtained from a deeper zone.

2.1.4. Minimum Setbacks

- a. The minimum setback distances set out in ARM 17.36.323 must be maintained for all proposed and existing individual and shared water sources. A drinking water supply well may not be constructed within 100 feet of a ground water mixing zone granted pursuant to ARM Title 17, chapter 30, subchapter 5.
- b. The reviewing authority may require greater than a 100-ft horizontal separation between a well and surface water if there is potential that the well may be influenced by contaminants in surface water. In considering appropriate separation between a well and surface water, the reviewing authority may consider factors such as well location, well construction, aquifer material, hydraulic connection between the aquifer and watercourse, and other evidence of the potential for surface water contamination. The reviewing authority may also require that the proposed water source be tested for surface water influence in accordance with Department Circular PWS-5.

2.2. CISTERNS

Cisterns used for water storage for individual and shared water systems must be designed according to chapter 5.

2.3. TREATMENT

2.3.1. Microbiologically Unsafe Water

The use of source water that contains total coliform bacteria, *E. coli*, or a known pathogen is prohibited for individual and shared water systems. In cases where initial samples are total coliform present, repeat samples may be collected for reevaluation. If repeat samples are total coliform absent, the source water may be considered for use.

2.3.2. Nitrate treatment

The Department cannot approve a water supply source that exceeds 10 mg/l total nitrogen. If alternative water sources are not available to serve the individual or shared system, the reviewing authority may allow use of the source water that exceed the 10 mg/L level with installation of appropriate nitrate treatment. The 10 mg/L limit is based on the maximum contaminant levels set by the US Environmental Protection Agency for public water supplies.

If point-of-use treatment is used, it must be provided for all taps potentially used for human consumption.

Nitrate treatment design, preparation of plans and specifications and submittal to the department must be completed by an entity competent in water treatment. Using design services of a professional engineer is encouraged.

Nitrate treatment should be designed in accordance with circular deq-1 for point-of-entry or point-of-use treatment except that point-of-use treatment may be used for nitrate/nitrite mitigation.

Reverse osmosis treatment technology is recommended. If reject water will be sent to a subsurface wastewater treatment and disposal system, please see circular deq-4 to ensure the subsurface wastewater treatment and disposal system is designed to accommodate the waste flow and constituents. Ion exchange and adsorptive media treatment for nitrate may not be used for non-public water systems.

2.3.3. Arsenic Treatment

Arsenic is a chronic contaminant, unlike microbial and nitrate contamination. For individual and shared wells, the department will require that an arsenic contamination is addressed in each submittal. If arsenic is detected in untreated source water at levels above the MCL set by EPA, a statement will be placed in the approval indicating that arsenic treatment is required and reviewing authority will allow use of the source water with installation of reverse osmosis treatment to bring the treated water below the MCL.

2.3.4. Other Contaminant Treatment

The use of untreated source water that is known to exceed levels based on MCLs for any constituent is discouraged for individual and shared water systems. If alternative water sources are not available to serve the individual or shared water system, the reviewing authority may allow use of the source water with installation of approved water treatment to bring the treated water below the MCL.

Treatment for MCL exceedances in individual water systems should follow the Department Circular DEQ-1 Design Standards for Point-of-Entry or Point-of-Use Treatment. The department encourages design of treatment for individual systems by a professional engineer.

3. MULTIPLE-USER WATER SYSTEMS

3.1. GENERAL

In selecting the source of water to be developed, the applicant must demonstrate, to the satisfaction of the reviewing authority, that an adequate quantity and quality of water will be available and that the water delivered to the consumer will meet the requirements outlined in this circular.

For multiple-user systems, the reviewing authority may require the applicant to create a homeowners' association, county water district, or other administrative entity that will be responsible for operation and maintenance and that will have authority to charge appropriate fees.

If more than one multiple-user water system is proposed for a subdivision, the systems must be tied together to ensure greater system reliability. **The department may consider a deviation from this provision if the applicant demonstrates that interconnection of the systems is physically impractical.**

The applicant shall submit to the reviewing authority an operation and maintenance plan for the multiple-user water system. The plan must ensure that the system will be adequately operated and maintained.

3.2. GROUND WATER

A ground water source includes all water from dug, drilled, bored, or driven wells and infiltration lines. Prior to construction of a drinking water well intended to serve a multiple-user water system, the proposed location and the plans and specifications must be approved by the reviewing authority in accordance with the requirements of this section.

A preliminary assessment for proposed ground water sources that may be under the direct influence of surface water prepared in accordance with Department Circular PWS-5 must be provided for each proposed multi-user water supply system

Well locations must be based on a source water delineation and assessment report prepared in accordance with Department Circular PWS-6.

3.2.1. Quantity

a. Source capacity

The applicant must provide Average Day Demand, Maximum Day Demand and Peak Instantaneous Demand calculations for existing and proposed water sources.

The total developed ground water source capacity must equal or exceed peak instantaneous demand unless adequate storage is provided. If adequate storage (average day demand plus fire flow) is provided, the groundwater source capacity must equal or exceed maximum day demand.

b. Water use estimates for design purposes

- i. Domestic use - 100 gpcd must be provided for average domestic use unless the applicant has sufficient data, acceptable to the reviewing authority, to show a

lesser quantity to be adequate. When estimating domestic use for living units, use 2.5 people per living unit in the calculations.

- ii. Commercial/industrial use – for non-residential water systems, the system must be capable of meeting peak demands. This is typically calculated from a fixture unit analysis per the UPC, AWWA Fixture Value Method, or by applying a peaking factor to the average day demand in gallons per minute or other means acceptable to the reviewing authority.
- iii. Irrigation - when irrigation water is provided, information must be submitted to the reviewing authority to show that adequate water will be available. Such information must include:
 - 1. the area to be irrigated in acres or square feet
 - 2. water requirements in inches/week
 - 3. proposed methods of controlling irrigation
- iv. Fire flows - fire flows must meet the recommendations of the agency in which the water system is being developed or, in the absence of such a recommendation, the fire code adopted by the State of Montana.

3.2.2. Quality

The applicant shall demonstrate that water quality is sufficient for the proposed multiple-user water system. The reviewing authority may not approve a proposed water supply system if there is evidence that, after approved treatment, the concentration of any water quality constituent exceeds the human health standards in Department Circular DEQ-7, or the maximum contaminant levels established in ARM Title 17, chapter 38, subchapter 2. The necessary quality and quantity of water must be available at all times.

a. Surface Water Influence

For proposed multiple-user wells, the Department will consider any of the following factors when evaluating direct surface water influence risk:

- i. The use of an irrigation gallery, or horizontal well.
- ii. A distance to surface water of less than 100 feet.
- iii. The potential for a static water level of less than 25 feet.
- iv. A well location downgradient of surface water.
- v. The absence of natural barriers to protecting the groundwater aquifer (e.g., laterally extensive shale, confined aquifer, etc.).

c. For existing wells, the Department will consider those factors listed in 1.3.1(b) and the following:

- i. Well construction does not meet current standards for casing, annular seal thickness and depth. Well construction standards are described in section 2.1.3 for individual and shared water systems of section 3.1.3 for multiple -user water systems.

ii. History of E. coli positive samples

d. Actual static water level below 25 feet. If the Department determines there is a direct surface water risk based on the information provided in d and c the applicant will be notified and may propose an alternate source or follow the procedure outlined in e.

e. If the Department determines there is a direct surface water risk the Department will require construction and testing separately before approval can go forward as well as the sampling listed below:

- i. Monthly lab testing of conductivity and turbidity for one year.
- ii. Monthly Total Coliform bacteria testing for one year.
- iii. Quarterly nitrate-nitrite testing for one year.
- i. Testing for organisms that indicate direct surface water influence using the Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA), Environmental Protection Agency, EPA 910/0-92-029 (Oct. 1992).

b. Microbiological quality

- i. Disinfection of every new, modified, or reconditioned ground water source must be provided in accordance with ARM 36.21.662(1) prior to and after placement of permanent pumping equipment.
- ii. More than 72 hours after disinfection, one water sample must be submitted to a laboratory certified by the Department of Public Health and Human Services for microbiological analysis with satisfactory results reported to the reviewing authority prior to placing the well into service.
- iii. If the reviewing authority determines, from the required application materials, that the source may be ground water under the direct influence of surface water in accordance with Department Circular PWS-5, then further assessment will be required, including:
 - (1) Monthly monitoring of temperature, pH, conductivity, and microbiological analysis (total coliform bacteria) for one year.
 - (2) Micro-particulate analysis (MPA) performed in both the fall and spring season.

b. Physical and chemical quality

- i. Every new, modified, or reconditioned ground water source must be examined for applicable physical and chemical characteristics by tests of representative samples in laboratories certified by the Department of Public Health and Human Services, with the results reported to the reviewing authority.

Testing must include nitrate/nitrite, total dissolved solids or conductivity, pH, and arsenic as a minimum for multiple-user water systems. Additional testing may be required for other parameters where the reviewing authority has information suggesting they may be present in harmful quantities or where additional regulatory requirements apply.

- ii. Samples must be collected and analyzed at the conclusion of the test pumping procedure prior to disinfection. The reviewing authority will require sample results to be submitted to the reviewing authority for review and approval prior to use of a new source or construction of a new system.

3.2.3. Location

a. Well location and Minimum Setbacks

Regarding a proposed well location, the reviewing authority must be consulted prior to design and construction as the location relates to required separation between existing and potential sources of contamination and ground water development. The minimum setback distances set out in Table 1.1 must be maintained for all proposed and existing multiple-user water systems. Wells must be located at least 100 feet from any structures used to convey or retain industrial, storm, or sanitary waste and state or federal highway rights-of-way.

b. Continued protection

Continued protection of the well site from potential sources of contamination must be provided through zoning, easements, deed notices, leasing, or other means acceptable to the reviewing authority. Easements and deed notices must be filed with the County Clerk and Records Office. Such protection must extend for at least a 100-foot radius around the well (well isolation zone). In addition, separation distances between proposed wells and potential sources of contamination must be defined and justified by the applicant following the source water delineation report prepared in accordance with Department Circular PWS-6.

The well isolation zone of a proposed or existing well may not be in a ground water mixing zone as defined in ARM 17.30.517 and also may not include easements that would conflict with the proposed use. Fencing of the site may be required by the reviewing authority.

Testing and Records

a. Yield and drawdown tests

- i. A test must be performed on every production well after construction or subsequent treatment and prior to placement of the permanent pump.
- ii. The test methods must be clearly indicated in specifications.
- iii. The test pump must have a capacity, at maximum anticipated drawdown, at least equal to the quantity required under Section 4.2.1.
- iv. The test must provide for continuous constant rate pumping at 1.0 times the design pump capacity for at least 24 hours.
- v. Data of the following at one-hour intervals or less as may be required by the reviewing authority:
 - (1) static water level.
 - (2) pumping rate.
 - (3) pumping water levels.

- (4) water recovery rate and levels; and
- (5) time of starting and ending each test cycle.
- vi. Data collection must begin at time zero. The test may be terminated if stabilized drawdown occurs for at least eight hours during the test. Stabilized drawdown is defined as a water level that does not fluctuate plus or minus 0.5 feet for every 100 feet of drawdown at the design pumping rate. When sufficient historical information is available, a step drawdown test may be approved by the reviewing authority.
- vii. Results must be reported electronically to the reviewing authority on Aquifer Test Data Form 633, available through the Montana Department of Natural Resources and Conservation (DNRC) Water Resources Division.
- viii. Geological data must be determined in accordance with ARM 36.21.667. A copy of the well log must be submitted to the reviewing authority.

3.3. GENERAL WELL CONSTRUCTION

All multiple-user wells must be constructed by a licensed water well contractor in accordance with Title 37, Chapter 43, MCA, and ARM Title 36, chapter 21, and the requirements outlined below.

The reviewing authority may require additional well construction and/or testing requirements not required in ARM Title 36, chapter 21, subchapter 6, or this circular to ensure that wells within a particular subdivision will provide an adequate water supply.

1. Minimum protected depths of drilled wells must provide watertight construction to such depth as may be required by the reviewing authority to:
 - i. exclude contamination; and
 - ii. seal off zones that are, or may be, contaminated or yield undesirable water.
2. Permanent steel casing pipe must:
 - i. be in accordance with ARM 36.21.640.
 - ii. when driven, be equipped with a drive shoe in accordance with ARM 36.21.644; and
 - iii. have joints in accordance with ARM 36.21.642.
3. Nonferrous casing materials
Plastic well casing must be in accordance with ARM 36.21.645 and 36.21.646.
4. Packers
Packers must be of material that will not impart taste, odor, toxic substance, or bacterial contamination to the well water. Lead packers must not be used.
5. Grouting requirements
 - i. All permanent well casing must be sealed in accordance with ARM 36.21.654 through 36.21.660. The casing must be provided with centralizers in accordance with ARM 36.21.649.

6. Upper terminal well construction.

- i. Permanent casing for all ground water sources must be in accordance with ARM 36.21.647, requiring the well head to extend above ground level a minimum of 18 inches.
- ii. Where a well house is constructed, the floor surface must be at least six inches above the final ground elevation.
- iii. Protection from physical damage and tampering must be provided.
- iv. The upper terminal must be constructed to prevent contamination from entering the well.
- v. Where well appurtenances protrude through the upper terminal, the connections to the upper terminus must be mechanical or welded connections that are watertight.

7. Development

Every well must be developed in accordance with ARM 36.21.653. The method of well development must be described on the well log.

8. Capping requirements

Temporary capping requirements must be in accordance with ARM 36.21.661.

3.4.13 Aquifer types and construction methods - special conditions

The following special aquifer types and construction methods must be reviewed by the reviewing authority on a case-by-case basis to ensure proper design and protection of public health: sand or gravel wells, gravel pack wells, radial wells, infiltration lines, dug wells and limestone or sandstone wells.

a. Consolidated formations

In drilled wells that penetrate an aquifer either within a consolidated or confining formation, sealing of the casing must conform to ARM 36.21.655.

b. Unconsolidated formations without significant clay beds

In drilled wells that penetrate an aquifer within an unconsolidated formation without significant clay beds, sealing of the casing must conform to ARM 36.21.656.

c. Unconsolidated formations with clay beds. In drilled wells that penetrate an aquifer within an unconsolidated formation with clay beds, sealing of the casing must conform to ARM 36.21.657.

d. Flowing wells

- i. When flowing water is encountered in the well, an unperforated well casing must extend into the confining stratum overlying the artesian zone. The casing must be adequately sealed into the confining stratum so as to prevent surface and subsurface leakage from the artesian zone.
- ii. If the well flows at land surface, it must be equipped with a control valve so that the flow can be completely stopped.

- i. Flowing wells may not be allowed to freely flow, for freeze protection or any other reason. The final well packer and pump house must address freeze protection.
- iii. The well must be completed with packers or appropriate sealing material that will eliminate leakage around the well casing.

3.4.14 Well pumps, discharge piping and appurtenances

a. Submersible pumps

Where a submersible pump is used, the top of the casing must be effectively sealed against the entry of water under all conditions of vibration or movement of conductors or cables.

b. Discharge piping

The discharge piping and appurtenances must:

- i. be designed to minimize friction loss.
- ii. have control valves and appurtenances located above the pumphouse floor when an above ground discharge is provided.
- iii. be protected against the entry of contamination.
- iv. be equipped with a check valve (in or at the well), a shutoff valve, a pressure gauge, and a smooth-nosed sampling tap located at a point where positive pressure is maintained.
- v. be equipped with a smooth-nosed sampling tap located at a point where positive pressure is maintained, but before any treatment chemicals are applied. The sample tap must be at least 18-inches above the floor to facilitate sample collection.
- vi. where applicable, be equipped with an air relief valve located upstream from the check valve, with exhaust/relief piping terminating in a down-turned position at least 18-inches above the floor and covered with a 24-mesh corrosion resistant screen.
- vii. be valved to permit test pumping and control of each well where more than one well is proposed.
- viii. have all exposed piping, valves, and appurtenances protected against physical damage and freezing; and
- ix. be constructed so that it can be disconnected from the well or well pump to allow the well pump to be pulled.
- x. The discharge piping must be provided with a means of pumping to waste but may not be directly connected to a sewer.

3.4.15 Casing vent

- a. Provisions must be made for venting the well casing to the atmosphere. Venting must be provided by a factory-manufactured vented well cap or fabricated vent assembly. All vents must be screened with corrosion-resistant material to prevent entry of insects and oriented to prevent entry of rainwater.

- b. Fabricated vents must terminate in a down-turned position, at or above the top of the casing or pitless unit in a minimum 1.5-inch diameter opening covered with a 24-mesh screen. The pipe connecting the casing to the vent must be of adequate size to provide rapid venting of the casing. Fabricated vent assemblies must be of such design and strength as to be vandal resistant.

3.3.1. Water level measurement

- a. Provisions (i.e., probe access tube or airline) should be made for periodic measurement of water levels in the completed well.
- b. Where pneumatic water level measuring equipment is used, it must be made using corrosion-resistant materials attached firmly to the drop pipe or pump column and in such a manner as to prevent entry of foreign materials.

3.4. ALTERNATE WATER SUPPLIES AND CONFIGURATIONS

Spring sources, surface water and any source of water other than a groundwater well are specifically prohibited from serving multiple-user water systems.

3.4.1. Cisterns

Where multiple-user water systems serve individual cisterns, maintained by the individual living unit or commercial unit owner, cisterns must be constructed in accordance with Chapter 6. multiple-user water systems that propose central storage to supplement water system demand must meet the criteria for Finished Water Storage and Booster Pumps, as outlined in this chapter.

3.5. TREATMENT

3.5.1. General

The need for and design of treatment processes and devices will depend on evaluation of the nature and quality of the water to be treated and the desired quality of the finished water. Treatment processes for multiple-user water systems installed for reasons other than Maximum Contaminant Level (MCL) compliance must meet the following conditions:

- a. chemicals must meet NSF Standard 60.
- b. equipment components meet appropriate NSF certification, and.
 - i. all cross-connection hazards are eliminated in accordance with the requirements of ARM 17.38.300 through 17.38.312

3.5.2. Disinfection

The use of source water that contains E. coli or a known pathogen is prohibited for multiple-user water systems.

The use of source water that contains total coliform bacteria, is discouraged for multiple-user water systems. In cases where initial samples are total coliform present, repeat samples may be collected for reevaluation. If repeat samples are total coliform absent, the source water may be considered for use.

If an alternative, total coliform bacteria absent water source is not available to serve the multiple-user water system, the Department may allow use of the water source with the installation of an approved disinfection system.

Design, preparation of plans and specifications, and submittal to the Department for approval of a disinfection system must be completed by a Professional Engineer. Such submittals must also meet the requirements of ARM 17.36.121.

Chlorination of multiple-user water systems must follow the Department Circular DEQ-3, Chapter 4 Design Standards. Other disinfection methods must follow the Department Circular DEQ-1 Design Standards.

3.5.3. Nitrate Treatment

The use of source water that exceeds the MCL for Nitrate (10 mg/L) is highly discouraged for multiple-user water systems. If alternative water sources are not available to serve the multiple-user water system, the Department may allow use of the source water with installation of Nitrate Treatment.

Design, preparation of plans and specifications, and submittal to the Department for approval of a Nitrate treatment system must be completed by a Professional Engineer. Such submittals must also meet the requirements of ARM 17.36.121.

Nitrate treatment must be designed in accordance with Circular DEQ-1 Design Standards. Reverse Osmosis is the preferred treatment technology for nitrate treatment in multiple-user water systems.

Ion exchange and adsorptive media treatment for nitrate may not be used for non-public water systems.

3.5.4. Other Contaminant Treatment

The use of source water that is known to exceed the Maximum Contaminant Level (MCL) for any constituent is discouraged for Multiple User water systems. If alternative water sources are not available to serve the Multiple User Water system, the Department will allow use of the source water with installation of approved water treatment to bring the treated water below the MCL.

Design, preparation of plans and specifications, and submittal to the Department for approval of treatment equipment required to reduce a contaminant with an MCL must be completed by a Professional Engineer. Such submittals must also meet the requirements of ARM 17.36.121.

Treatment for MCL exceedances in multiple-user water systems must follow the Department Circular DEQ-1 Design Standards.

3.6. BOOSTER PUMPING FACILITIES

3.6.1. General

Booster pumping facilities must be designed to maintain the sanitary quality of pumped water. Subsurface pits or pump rooms and inaccessible installations must be avoided. Pumping stations must not be subject to flooding.

Central booster pumping facilities designed to draw water from a central storage reservoir and pressurize the multiple-user water distribution system must be designed by a Professional Engineer.

3.6.2. Location

The pumping station must be located to ensure that the proposed site will meet the requirements for sanitary protection of water quality, hydraulics of the system, and protection against interruption of service by fire, flood, or any other hazard.

3.6.3. Pumps

The pump or pumping units must be sufficient to equal or exceed the peak instantaneous demand.

3.6.4. Appurtenances

a. Valves

Each pump must have an isolation valve on the intake and discharge side of the pump to permit satisfactory operation, maintenance, and repair of the equipment. If foot valves are necessary, they must have a net valve area of at least 2.5 times the area of the suction pipe and they must be screened. Each pump must have a positive-acting check valve on the discharge side between the pump and the shut-off valve. Surge relief valves, slow acting check valves, or other means to minimize hydraulic transients must be incorporated in the system design.

b. Piping

Piping must:

- i. be designed so that friction losses will be minimized.
- ii. not be subject to contamination.
- iii. have watertight joints.
- iv. be protected against surge or water hammer and provided with suitable restraints where necessary; and
- v. be such that each pump has an individual suction line or that the lines are manifolded so that they will insure similar hydraulic and operating conditions.

c. Gauges and meters

Each pump:

- i. must have a standard pressure gauge on its discharge line.
- ii. should have a compound gauge on its suction line; and
- iii. must have a means of measuring the discharge

3.7. FINISHED WATER STORAGE

3.7.1. General

The materials and designs used for finished water storage structures must provide stability and durability as well as protect the quality of the stored water. Steel, concrete, fiberglass-reinforced plastic, and flexible membrane water storage facilities must follow current AWWA Standards. Porous material, including wood and concrete block, are not suitable for potable water contact applications.

3.7.2. Pressure Tanks

Hydropneumatic pressure tanks must meet applicable ASME code requirements or must satisfactorily pass a hydrostatic test of 1.5 times the maximum allowable working pressure of the tank. The maximum allowable working pressure must be marked on each tank.

a. Location

The tank must be located above normal ground surface and be completely housed.

b. System design and sizing

The capacity of the wells and pumps in a hydropneumatic system must be equal to the peak instantaneous demand. The active storage volume of the hydropneumatic tanks must be sufficient to limit pump cycling to the manufacturer's and industry's recommendations. Maximum cycling frequency for pumps not using a variable speed drive must be determined for each pump and for any combination of pumps operated by the same pressure switch when consumer demand is equal to one-half of the pump(s) capacity. Maximum cycling frequency for pumps using a variable speed drive programmed to either maintain constant pressure, constant flow, or match the system design curve, must be determined when the customer demand is one-half of the minimum pumping rate. Reduction of required tank volume for systems with alternating pump controls will not be allowed.

c. Piping

Each tank in a multiple tank system must have bypass piping or valves to permit operation of the system while the tank is being repaired or painted.

d. Appurtenances

i. Each tank must have a means of draining, automatic or manual air blow-off, and a means for adding air.

ii. Control equipment consisting of a pressure gage, pressure relieving device, and pressure operated start-stop controls for the pumps must be provided for the hydropneumatic tank system. Installing a shut-off valve between the pump and the pressure operated start-stop controls must be avoided when possible.

- iii. The pressure relieving device must prevent the pressure from rising more than 10 percent above the maximum allowable working pressure. The discharge capacity of the pressure relieving device must be adequately sized. Pressure gages must have a range of no less than 1.2 times the pressure at which the pressure relieving device is set to function.

3.7.3. Storage Reservoirs

Storage facilities/reservoirs, sometimes referred to as gravity storage, intended to provide water volume necessary to augment the capacity of the well source(s) to satisfy all system demands occurring on the maximum day, plus fire flow demands where fire protection is provided must be designed by a Professional Engineer and must meet the design criteria of Circular DEQ-1 Design Standards.

3.8. DISTRIBUTION SYSTEMS

- a. Materials
 - i. Standards

All materials including pipes, fittings, valves, and fire hydrants must conform to the latest standards issued by the AWWA and ANSI/NSF, where such standards exist, and be acceptable to the reviewing authority. In the absence of such standards, materials meeting applicable product standards and acceptable to the reviewing authority may be selected.

- b. Water Main Design
 - i. Pressure

All water mains, including those not designed to provide fire protection, must be sized after a hydraulic analysis based on flow demands and pressure requirements. The system must be designed to maintain a minimum normal working pressure of 35 psi. Maximum normal working pressure should be approximately 60 to 80 psi. Minimum pressure under all conditions of flow (e.g., fire flows) must be 20 psi. Minimum required pressures must be based on those occurring at ground level at the highest building sites or fire hydrant served by the proposed water mains excluding service line head losses.

- ii. Diameter

The mains must be sized to handle design flows.

- iii. Hydrants

Water mains not designed to carry fire-flows may not have standard sized fire hydrants connected to them.

- iv. Dead ends

Dead ends must be minimized by looping of all mains whenever practical.

v. Valves

Sufficient valves must be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs.

c. Installation of Mains

i. Standards

Specifications must incorporate the provisions of the AWWA standards and manufacturers recommended installation procedures.

ii. Cover

All water mains must be covered with sufficient earth or other insulation to prevent freezing.

iii. Pressure and leakage testing

The installed pipe must be pressure tested and leakage tested as required by the reviewing authority.

iv. Disinfection

4. DEVELOPMENT OF SPRINGS

4.1. GENERAL

This section applies to the development of springs for individual or shared water systems. Springs may not be used as sources for multiple-user water systems. The quality, quantity, and dependability requirements of Chapter 1 of this circular must be met.

If the proposed spring is determined to be under the influence of surface water, it may not be used as a water source for an individual or shared water systems.

Springs may only be proposed for individual or shared water systems if the applicant illustrates that groundwater quality, quantity, or dependability are unacceptable for proceeding with a well.

4.2. DEFINITION

Springs occur where the natural flow of ground water rises to the surface.

4.3. TYPES

- a. Gravity springs discharge from unconfined aquifers, which are water-bearing aquifers that rest on an impervious stratum and outcrop to the surface.
- b. Artesian springs discharge from confined aquifers, which are aquifers that have both an upper and lower layer of impermeable material that forms a barrier against contaminants.
- c. Seepage springs are where water flows or seeps out of sand, gravel, or other porous material.

4.4. DEVELOPMENT REQUIREMENTS

Development of the spring depends on the geological formations and hydrological characteristics of the water-bearing formation. The general geologic formations for each type of aquifer and spring are shown in Figure 1 below. The flow from a spring may vary considerably with changes in the water-table or artesian pressure. Some springs are very susceptible to contamination. Before developing a spring for a water supply, the owner should determine the nature of the water and the risk of contamination.

- a. Selection of a spring with enough capacity to provide the required quantity and quality of water throughout the year, and
- b. When a spring is chosen for a water supply, the owner must determine that the water quality is acceptable, the quantity of water available is adequate to meet the needs of the water system, and the spring is protected from contamination. Seepage springs are very susceptible to contamination and should not be used as a water source.
- c. The quantity of water available from a spring can vary significantly due to changes in ground water storage. Depending on the type of spring, changes in ground water storage can come from seasonal variations such as dry periods and withdrawals of nearby wells.

4.5. WATER QUALITY AND QUANTITY TESTING REQUIREMENTS

The applicant must contact the Department prior to gathering information related to a proposed spring source. Prior to approval of a spring for potable use, the following data must be collected and submitted to the reviewing authority and found to be acceptable.

- a. Springs must meet the requirements for wells regarding quality, quantity and dependability included in Chapters 2 through 4 of this Circular. Additionally, springs must provide additional information at specified times of the year to further evaluate sustainability and potential for surface water influence.
- b. The following water quality data must be collected from the proposed spring source:
 - i. Monthly lab testing of conductivity and turbidity for one year.
 - ii. Monthly Total Coliform bacteria testing for one year.
 - iii. Quarterly nitrate-nitrite testing for one year.
 - iv. Testing for organisms that indicate direct surface water influence pursuant to the Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA), Environmental Protection Agency, EPA 910/0-92-029 (Oct. 1992) with low-risk results, one accomplished during the spring (May and June) high water season and one during the fall low flow (October) season.
- c. To assess water quantity and dependability, flows must be measured monthly for one year. Coordinate with the Department to ensure that flow measurement from the spring captures at least one reading during the seasonal low-flow period.

4.6. PROTECTION OF THE WATER FROM CONTAMINATION

- a. Steps must be taken to prevent contamination of the spring during construction of the improvements necessary to supply the source water.
 - i. If the spring is artesian, a vertical well is drilled, or collection pipe is installed into the aquifer (either directly at the spring or near the spring). Water rises in the well or collects in the pipe due to the pressure of the artesian spring. Unlike ground water wells, a pump may not be needed to raise the water in the well or fill the collection pipe.
 - ii. Pumps may be used to deliver the water to the storage tank or distribution system. If the spring is gravity driven, then a horizontal well (similar to an infiltration gallery) or collection pipe is constructed to collect the spring water before it exits at the surface. Since water from a gravity spring outcrop flows to the surface by gravity, pumps may only be needed to feed the water to a storage tank or distribution system.
- b. Springs are susceptible to contamination by surface water and must be protected from surface runoff. Contamination sources include livestock, wildlife, crop fields, forestry activities, wastewater treatment systems, and fuel tanks located upgradient from the spring outlet. Changes in color, taste, odor, or flow rate indicate possible contamination by surface water. To protect the springs, the following steps must be taken:

- i. Divert all surface water away from the spring and protect the spring from flooding by constructing a surface diversion ditch or berm upgradient of the spring to divert surface runoff away from the spring.
- ii. Fence the area at least 100 feet in all directions around the spring to prevent contamination by animals and people who are unaware of the spring's location,
- iii. Provide access to the storage tank for maintenance but prevent unauthorized entrance to the tank by installing locks.
- iv. Avoid vehicle traffic and storage of chemicals and fuels upgradient of the spring outlet.
- v. Monitor the quality of the water regularly by checking for contamination. A noticeable increase in turbidity or change in flow after storms is an indication that surface runoff is reaching the spring and possibly contaminating the water.

4.7. SPRING BOX

The features of a spring box must include:

- a. A watertight basin intercepting the source which extends to bedrock or a system of collection pipes and a storage tank.
- b. A cover to protect against entrance of surface water, debris, and animals or humans.
- c. Provisions for cleaning out and draining the tank.
- d. Provisions for overflow and venting the tank.
- e. A connection to the distribution system or backup supply.
- f. When more than one spring is piped to a common storage tank, each spring development must have valves and piping that can be isolated from the rest of the system.
- g. The spring box should be made of reinforced concrete. Alternate construction materials may be considered by the reviewing authority if adequate justification is provided illustrating quality construction and longevity can be achieved with the alternate spring box material.
- h. The spring box cover must be watertight to prevent undesirable water from entering. The cover must be lockable, watertight, with an overlapping lid to prevent the access of unauthorized parties and contaminants and surface water from entering (Figure 2).
- i. Provide an overflow to ensure that water pressure does not build up and damage the spring box.
- j. Provide a drain from the spring box to allow access for maintenance and flushing. Provide a screen on the outlet of the drain.
- k. The piped outlet from the spring box must be located a minimum of 6 inches above the bottom of the spring box to minimize the amount of sludge that is drawn into the intake.
- l. If the spring box also functions as a storage tank or is connected to a storage tank, the storage tank must meet the requirements of Chapter 6 of this circular.

4.8. DIVERSION DITCH

- a. A diversion ditch around the uphill end of the spring area is needed to keep rainwater from flowing over the spring area and infiltrating the ground. An impervious barrier, such as clay

or a plastic liner, over the spring area will help prevent potential contaminants from entering the collection facilities.

- b. Springs must meet the setback distances outlined in Chapters 2 and 3 of this circular.

4.9. DISINFECTION OF SPRINGS

4.9.1. Construction and Maintenance

Springs are often contaminated with bacteria during construction or maintenance. All new and repaired water systems should be disinfected using shock chlorination.

4.9.2. Shock Chlorination

Shock chlorination requires a concentration of at least 200 parts per million (ppm) chlorine. (As a reference, 200 ppm is the same proportion as 1 pound of salt in about 600 gallons of water.) To obtain this concentration, add 3 pints of liquid chlorine laundry bleach (such as "Clorox," which is about 5 percent chlorine) for each 100 gallons of water to be disinfected. If using liquid chlorine bleach, use a new bottle because the chlorine content of the bleach deteriorates in a relatively short period of time.

Follow these steps to disinfect spring-fed water systems with chlorine:

- a. Remove debris and sediment from the spring box, storage tank and distribution system. Scrub all interior surfaces with a strong chlorine solution (1 gallon of liquid chlorine laundry bleach per 10 gallons of water). Be sure to wear gloves and other appropriate protective clothing. Do not enter the storage tank, spring box or any confined space unless you have received training and use the proper equipment and safety precautions necessary for confined space entry.
- b. Disinfect the spring box and storage tank by first allowing it to fill with fresh spring water. If the spring flow is small, close the main line valve and the outlet pipe and add chlorine to the spring box through the vent line. Use the 200-part-per-million chlorine concentration described above. Hold the chlorinated water in the spring box and storage tank for at least 12 hours. Keep the overflow valve open. The chlorinated water used for disinfection must not be discharged to a stream, river, or other waterway where damage to aquatic life may occur. De-chlorination may be necessary prior to discharge. If the flow rate is too high to retain water in the spring box, feed the chlorine solution into the spring box continuously for at least 12 hours.
- c. Disinfect the water distribution system including pressure tanks, storage tanks, pipelines, valves, and faucets by pumping chlorinated water through the system. Open all faucets until a strong chlorine odor is detected at each one. Close the faucets to allow the chlorine solution to remain in the system for at least 12 hours.
- d. Open all valves and faucets to allow fresh spring water to flow through the system until no chlorine odor or taste can be detected. The chlorinated water used for disinfection must not be discharged to a stream, river, or other waterway where damage to aquatic life may occur. De-chlorination may be necessary prior to discharge.
- e. Test the spring water for bacterial contamination 72 hours after chlorine has been removed from the spring and household system. It is important to flush the system

completely because the sources of chlorine used above are not manufactured for human consumption.

4.9.3. Frequent Contamination

If bacterial contamination occurs on a regular basis because of surface sources entering the spring, continuous chlorination would be necessary. Continuous chlorination is necessary if bacterial contamination continues after shock chlorination. In this system, equipment is used to feed chlorine continuously in sufficient amounts to kill bacteria. If continuous chlorination is necessary, retain the services of a qualified person to design the system. A professional engineer is recommended for such design. The proper chlorine feed rate depends on water temperature, pH, and pumping rate. Use a chlorine residual kit to determine if the feed rate should be increased or decreased to obtain the proper chlorine residual.

4.10. WATER TESTING

Spring water should be tested each year to determine if surface-water contamination is a problem for the following:

- a. Bacteria,
- b. Nitrates,
- c. Turbidity, and
- d. Conductivity.

If bacterial contamination is detected at any time in the water, properly disinfect the system and retest the water before using it. Springs are susceptible to contamination by giardia, cryptosporidium, and other microorganisms that are not detected by standard bacterial tests. Test for these microorganisms if spring water is suspected as a source of illness.

Figure 1. Types of Aquifers and Springs

Figure 2. Spring Protection

5. CISTERNS (WATER STORAGE TANKS)

5.1. GENERAL

This section must be used for the designing cisterns for individual and shared water systems. multiple-user water systems must use Circular DEQ-1 Design Standards for design and construction of central storage. If a multiple-user water system fills individual cisterns serving a single or shared living units or commercial units, the cistern criteria of this chapter must be used for such design.

Cisterns may be used only if a potable water source is available for hauling within a reasonable distance from the cistern or the water is supplied by a low production on-site well or other source approved by the reviewing authority and the cistern meets the designs standards listed in this Circular.

When hauled water is used to fill a cistern, it must be provided from a public water system, and it must be hauled and disinfected in accordance with ARM Title 17, chapter 38, subchapter 5. Certification of adequate water supply to be hauled must be provided as follows:

- a. a letter provided by a licensed water hauler that the subdivision will be served by the hauler's business, or
- b. A certification from the public water system providing water supply that water is available from the public water system to serve the applicant's system.

Cistern facilities must be sized to provide the peak instantaneous demand of the system.

5.2. PLACEMENT

Installation of cisterns in above-ground, heated structures is encouraged. Such installations allow the structural and watertight integrity of the cistern to be monitored more easily than buried cisterns.

- a. A buried cistern must be located 10 feet from any foundation and have positive drainage away from it to prevent any surface water from contaminating the interior of the cistern or its water supply.
- b. The cistern is required to be 50 feet from wastewater treatment drainfields and 25 feet from septic tanks.
- c. Precautions must be taken to assure that water cisterns and their accessories will not freeze during winter months. For buried cisterns, the top of the cistern (excluding the access lid(s)) must be installed below the frost line. Special care must be taken to seal the cistern access lid and any penetrations into the cistern.
- d. If soil cover below frost depth cannot be achieved, the top of a buried cistern must be insulated with a high-density insulation board. One inch of high-density insulation board is approximately equal to one foot of earth in insulation value.
- e. Cisterns installed above-ground must be located within a heated structure.

5.3. CONSTRUCTION

- a. Material

Water cisterns may be constructed of precast concrete, cast-in-place concrete, polyethylene, or fiberglass. Cistern capacity, site topography, and the availability of the different types of cisterns will help determine the most economical type of water cistern for each application.

- i. Usually, a local precast concrete company will manufacture each precast cistern “to order”, casting-in the appropriate size(s) of connection fittings, access(es), overflow(s) and vent(s). The cistern will then be shipped to and installed at its final location.
- ii. Cast-in-place concrete contractors will also build cisterns “to order”; however, the cistern will be built in-place. Generally, cast-in-place concrete cisterns are most cost effective in capacities greater than 5,000 gallons.
- iii. Polyethylene water cisterns can be cost effective for small capacities (less than 1,500 gallons) and for applications in remote areas. Polyethylene cisterns are usually purchased locally; however, they are not made “to order”.
- iv. It is convenient to have a drainpipe and a “Direct-Bury” rated valve to empty the cistern, especially for cleaning. (See Figure 1) Such a drain can be installed if there is sufficient slope to the ground so the drainpipe daylights to the surface, as for instance on a hillside or bank of a nearby coulee or ravine. This pipe must slope slightly away from the cistern and must be at least 2” in diameter. It must be set so the cistern will drain completely. The drain or overflow pipes should discharge over a drainage inlet or splash pad to prevent erosion and promote proper drainage away from the cistern. No drain or overflow may be connected directly to a sewer or a storm drain. All overflow pipes shall be located so that any discharge is visible. The overflow pipe shall open downward and be screened with 24-mesh noncorrodible screen to prevent entry by insects, birds, and other animals.

b. Precast Concrete & Cast-in-Place Concrete Construction

All cisterns must be structurally sound and be capable of withstanding loads created by 6 feet of burial. Precast concrete cisterns must be installed in accordance with their manufacturer’s recommendations.

- i. The walls and floor of precast concrete cisterns must be at least 3 inches thick if adequately reinforced with steel rebar and at least 6 inches thick if not reinforced with rebar.
- ii. Cast-in-place cisterns must have a minimum wall thickness of at least 6” and must be reinforced with steel rebar.
- iii. Concrete for cisterns must have a water/cement ratio less than 0.45, a 28-day compressive strength of at least 4,000 psi, and must be made with cement conforming to ASTM C-150, Types I, I-II, II, III, or V.
- iv. All concrete cisterns must be constructed from materials approved for potable water, including form oil, gaskets, and joint sealant. Many commercially available form oils are not approved for nor intended for use on potable water systems. The cistern manufacturer must keep on file information showing these materials are approved by their manufacturers for potable water applications. The cistern manufacturer (or contractor for cast-in-place) must guard against the use or accidental exposure to any toxic materials or substances during all phases of manufacturing, curing, testing and delivery operations.

c. Polyethylene and Fiberglass Construction

- i. Polyethylene and fiberglass cisterns: All polyethylene and fiberglass tanks used for cisterns must be specifically manufactured for potable water in accordance with FDA food-grade specifications, NSF standards or other nationally recognized standards for potable water. Documentation from the manufacturer stating that the cisterns are approved for potable water must be available for inspection.
- ii. Polyethylene and fiberglass cistern must be installed according to their manufacturer's specific instructions. Particular attention must be paid to bedding material, backfill material, testing and operation.

5.4. OPERATION AND MAINTENANCE

The cistern must be inspected periodically to ensure that the lids and access hatch are operating properly, and that no deterioration has occurred to any part of the cistern. Pumps, wiring, floats, and piping must also be checked periodically for indications of failure or leaking.

5.5. CLEANING AND DISINFECTION

- a. After initial construction of the cistern (or placement if cistern is precast, polyethylene or fiberglass) or after any maintenance, the cistern must be flushed to remove any sediment and thoroughly disinfected. This includes pump or float replacement or any plumbing work that has occurred within the cistern.
- b. Prior to filling and using a cistern, it must first be cleaned and disinfected. Cleaning, of all types of cisterns, requires sweeping and removing all debris, dirt, and dust from the inside of the cistern. If this requires entering the cistern, every precaution must be taken to prevent suffocation and breathing toxic fumes. NO CISTERN SHOULD BE ENTERED UNTIL APPROPRIATE MEASURES HAVE BEEN TAKEN TO ENSURE THE CISTERN'S AIR QUALITY IS SAFE AS DIRECTED BY OSHA CONFINED SPACE RULES, CODE OF FEDERAL REGULATIONS, TITLE 29-LABOR. NO CISTERN SHOULD BE ENTERED UNLESS THE PERSON ENTERING THE TANK HAS BEEN TRAINED IN CONFINED SPACE ENTRY AND FOLLOWS THE APPROPRIATE SAFETY PROCEDURES FOR ENTRY. It is also recommended that the interior be cleaned with a pressure cleaner.
- c. Disinfection of a cistern can be accomplished by using a solution of household bleach at a concentration of between 100-200 ppm. Common household bleach containing approximately 5% chlorine by weight may be used. Approximately 4 oz. Chlorine per 5 gallons of water will provide the proper concentration. All inside surfaces must be brushed with this solution. Allow a contact time of 12 to 24 hours.
- d. The cistern must now be filled with water from a potable water source. Faucets and water taps must be turned on in the commercial unit or living unit. After the water has run for a few minutes, turn off all the faucets and taps and again let the water stand for 12 to 24 hours. This will disinfect all the water lines of the delivery system.
- e. After the allotted time, the cistern must be emptied, and the water lines drained. The chlorinated water is not safe for human consumption. The chlorinated water used for disinfection must not be discharged to a stream, river, or other waterway where damage to aquatic life may occur. The chlorinated water must not be drained to a sewer system. The cistern must now be filled a second time from a potable water source. This water should now be ready for use. If the cistern is constructed from concrete, it may be desirable to use at least 3 loads of water prior to drinking the water. The water may still have a "chalky" appearance and may also have a slight "cement taste".

- f. It is highly recommended that cistern water be sampled annually for bacteriological contents. Other guidelines would be to drain, clean, and disinfect a cistern approximately every five years, especially if a water sample indicates contamination.

5.6. FILLING

- a. The water supply used to fill the cistern must be a potable source that is hauled in a container that is properly constructed and has been cleaned and disinfected. The cistern must be filled from potable water sources provided by public water supplies and hauled by either a licensed water hauler or the owner in accordance with the water hauling regulations.
- b. Hoses as well as the water hauling tanks used for filling the cistern need to be cleaned and disinfected periodically to ensure the water hauled remains potable. The disinfection guidelines outlined above describe the process to clean and disinfect hoses and hauling tanks.
- c. These hauling tanks must only be used for hauling potable water and must never be used for the hauling of any toxic chemicals or poisons. If the tanks are used regularly, only occasional disinfection is necessary. If the tanks are used periodically, then disinfection prior to each use must occur.
- d. The hose to fill the cistern must never be placed inside the cistern where the hose can be submerged in the water causing possible contamination.

5.7. BOOSTER PUMPING FACILITIES

5.7.1. General

Booster pumping facilities are required at installations where well production cannot meet the required well quantity thresholds for a shared well outlined of this chapter and must be augmented with cistern storage and pumping equipment.

5.7.2. Location

The pumping station must be located to ensure that the proposed site will meet the requirements for sanitary protection of water quality, hydraulics of the system, and protection against interruption of service by fire, flood, or any other hazard.

5.7.3. Pumps

The pump or pumping units must be sufficient to equal or exceed the peak instantaneous demand.

5.7.4. Valves

Each pump must have an isolation valve on the intake and discharge side of the pump to permit satisfactory operation, maintenance, and repair of the equipment. Each pump must have a positive-acting check valve on the discharge side between the pump and the shut-off valve.